

**REMARKS**

Claims 1 to 21 are all the claims pending in the application.

Claims 1-4 and 6-8 have been rejected under 35 U.S.C. § 102(a) as anticipated by the S. Wada et al article appearing in the Proceedings of the IEEE International Symposium on Applications of Ferroelectrics, 2002, pages 263-266.

Applicants submit that Wada et al do not disclose or suggest the presently claimed invention and, accordingly, request withdrawal of this rejection.

The present invention as set forth in claim 1 is directed to a barium titanate, which is single crystal in the form of particles, wherein 20% or more by number of the total particles do not contain a void having a void diameter of 1 nm or more.

Wada et al disclose nm-size impurity free and defect free barium titanate single crystal powder particles, but do not disclose or suggest barium titanate particles wherein 20% or more by number of the total do not contain a void having a diameter of 1 nm or more.

Wada et al do not disclose the percentage of defect-free particles.

The Examiner recognizes that Wada et al do not disclose the percentage of defect-free particles, but argues that “the language of the author leads one to reasonably believe that . . . nearly all of the particles created were free of defects.”

Wada et al disclose, at page 265, right-hand column, that the actual density of the particles measured by a pycnometer method was  $5.78 \text{ g/cm}^3$ , whereas the theoretical density of the particles calculated from the lattice constant was  $5.89 \text{ g/cm}^3$ .

Since  $\text{Ba/Ti} = 1.000$ , as disclosed in Wada et al at page 263, in the “Experimental” section, the obtaining by Wada et al of a lower actual density than the theoretical density necessarily indicates that the Wada et al particles have voids.

In Wada et al, the void volume of the particles calculated from the actual and theoretical densities is about 1.7%.

Therefore, applicants submit that Wada et al do not disclose or suggest the subject matter of claim 1 and the claims dependent thereon.

The Examiner responds to applicants' arguments that the 2002 Wada et al article does not disclose or suggest "barium titanate particles wherein 20% or more by number of the total do not contain a void having a diameter of 1 nm or more" by stating that Wada et al disclose a product that is "impurity free" and "defect free."

The Examiner further argues that defects in barium titanate are due to the removal of hydroxyl groups, which leave voids having a diameter of 1 nm or more. The Examiner points out that Wada et al discloses, at page 265, col. 2, that their barium titanate contains no lattice hydroxyl groups, only absorbed hydroxyl and carbonate groups. The Examiner argues that since no lattice-hydroxyl groups are present within the barium titanate, no voids can be produced due to the removal of such lattice groups.

Thus, the Examiner asserts that (1) since Wada et al article mentions that the particles are "impurity-free, defect-free," it is considered that voids are not present; that (2) since the Wada et al article refers to "no lattice OH group," it is considered that no OH group exists in the lattice.

In response, although Wada et al refer to their product as "impurity-free, defect-free," the Wada et al article does not provide data to support this description.

Wada et al filed a Japanese patent application No. 2001-209516, which has been published as Unexamined Patent Publication No. 2003-26423, for the same invention as that of

Wada et al article cited in the Office Action. Applicants attach hereto a copy of JP 2003-26423 and a JPO machine translation of JP '423. JP '423 includes more detailed information than is shown in the 2002 Wada et al article.

JP '423, in paragraphs [0083] to [0085] describes the thermal weight losses as follows:

[0083] TG-DTA data was measured for sample (2) . The sample was heated from a room temperature to 1000°C by 10°C/min and air was passed through the sample chamber. The measurement result is shown in Fig. 17. The TG curve had a sudden weight loss near 100°C and a loose weight loss in a range of from 400°C to 600°C. The whole weight loss was about 5%. The result of calculation of change in the weight at the room temperature between before and after the measurement was summarized in Table 10.

[0084]

Table 10  
MASS CHANGE by TG-DTA

<b>before heating (g)</b>	<b>after heating (g)</b>	<b>reduced wt (g)</b>	<b>reduced wt (%)</b>
0.0354	0.0346	0.008	2%

[0085] A big difference was seen between the weight loss after measurement (%) in Fig. 17 and the weight loss in Table 10. It was considered that since the weight change at the room temperature occurred by adsorption of water on the surface of the particles because the weight was measured at the room temperature after the heating, by which the weight increased in comparison with the weight at 1000°C in TG-DTA. Also, since it is considered that the particles had grain growth during heating for the TG-DTA, a half of the weight loss in the TG-DTA was considered due to adsorbed water.

As can be seen from the above, the weight loss at 200°C or lower is considered to be caused by water adsorption, and the weight loss around 600°C is considered to be caused by the loss of the hydroxyl group in the lattice and constitutes as much as 2%.

In relation to this, paragraph [0090] of JP '423 describes that the hydroxyl group is less in the lattice. That is, JP '423 does not state that the lattice has no hydroxyl group, but does state that the hydroxyl group is present in the lattice, although it is present in a less amount.

Further, the Examiner responds to applicants' argument that the density of the Wada et al particles are less than the theoretical density which, according to applicants, indicates that the Wada et al particles must have voids.

The Examiner states that this argument fails to take into consideration other factors which can lead to perturbations in the apparent density of nanoparticles. Among other things, the Examiner refers to the c/a ratio and variations in particle size that greatly affect the lattice parameter of the barium titanate.

The Examiner also points out that the Wada et al article employed a pycnometer to measure the density of the nanoparticles which according to the Examiner is an aqueous method. The Examiner further states that Wada et al disclose that there are adsorbed gas species on the surface of the barium titanate. The Examiner asserts that in an aqueous method, these adsorbed gases would decrease the apparent density of the particles.

Thus, the Examiner argues that since the density of fine particles measured by the pycnometer method becomes smaller by the effect of lattice disturbance and surface gases, even if the density is smaller than the theoretical density, one cannot conclude that voids are present.

However, applicants disagree with the Examiner's analysis and submit that it is not correct.

In particular, although the Examiner asserts that the density tends to be lower for fine particles due to surface adsorbed gases etc., applicants point out that since it is natural in practical measurement that particles are treated by vacuum for air removal before the measurement and an excellent compatible solvent is selected, the experimental error range (accuracy of density resolution) is only within about  $0.0001 \text{ g/cm}^3$  if a measurement is conducted

appropriately. See page 1 of the attached reference, “Alfa Mirage Co. Ltd., Electronic Densimeter SD-200L,” where an accuracy of  $0.0001 \text{ g/cm}^3$  is disclosed for a pycnometer.

Further, although the Examiner asserts that the density of fine particles becomes smaller than the theoretical density due to the dispersion of the lattice constant, this is not correct since the Wada et al article states that the theoretical density used was obtained by calculation from the lattice constant. See page 265, right column, line 19 of the Wada et al article.

The Examiner further argues that Wada et al disclose, at page 265, an exemplary TEM image which, according to the Examiner, shows a seemingly perfect single crystal under TEM observation. The Examiner states that there is no disturbance in the lattice of this particle, meaning there are no voids, dislocations or grain boundaries.

In response, even if a TEM image shows a single crystal, the crystal may have voids. For example, natural quartz and the like have many voids and defects although they are single crystals.

As can be seen from the above discussion, Wada et al do not disclose or suggest the present invention.

The Wada et al article discloses only barium titanate having a low density and comprising voids, and the process disclosed in the Wada et al article is different from that of the present invention.

Therefore, Wada et al do not defeat the novelty and non-obviousness of the present invention.

In view of the above, applicants submit that Wada et al do not disclose or suggest the subject matter of the present claims and, accordingly, request withdrawal of this rejection.

Claim 5 has been rejected under 35 U.S.C. § 103(a) as obvious over the 2002 Wada et al article in view of U.S. Application No. 10/244828 to Venigalla et al, which was published as U.S. Patent Appln. Pub. No. 2003/0059366 to Venigalla et al.

Claim 5 depends from claim 1. Accordingly, applicants submit that claim 5 is patentable over Wada et al for the same reasons as claim 1, as discussed above. Venigalla et al do not supply the deficiencies of Wada et al.

Neither Wada et al nor Venigalla et al disclose or suggest that a barium titanate which is a single crystal wherein 20% or more by number of the total particles do not contain a void having a void diameter of 1 nm or more.

In view of the above, applicants request withdrawal of this rejection.

At page 10 of the Office Action, the Examiner states that applicants' arguments with respect to the provisional obviousness-type double patenting rejection are not persuasive and, therefore, this rejection is maintained. This is the only place in the Office Action where the Examiner discusses the double patenting rejection.

In the previous Office Action, claims 1-8 were provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1 and 2 of copending application no. 10/189,371.

Applicants have previously argued that since the claims of the copending Appln. No. 10/189,371 have not yet issued and have been rejected, that the present double patenting

rejection is premature and that applicants therefore defer responding to the double patenting rejection. Applicants continue to maintain this position. If the claims of the present application are in condition for allowance before the copending application is allowed, the double patenting rejection can be withdrawn and the present application can be passed to issue.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

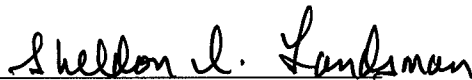
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